

SOFIA Science Steering Committee Meeting #17

July 23, 2001

Dominic Benford

Introductions:

Eric Becklin welcomes everyone. Mick Edgar (CASIMIR) is new; Dave Morrison (astrobiology at Ames) here again, and Ken Souza (Dave's deputy). Ian McLean (FLITECAM) is present. Hans-Peter Röser (DLR) is here. Paul Hertz (HQ) is here. Cliff Imprescia is relatively new; will give overview.

Juleen needs transparencies.

Program Status: Cliff Imprescia

Program summary (we know all this). SOFIA team includes many companies. SOFIA science: unique & versatile, but primary goal is to get the observatory working.

Level 1 requirements: Several basic req'ts, but may not all be met at ORR.

Status: \$35M overrun found in FY00; \$30M more overrun in November. SOFIA will delay operations & use operations money to build observatory. Extending for 2 more years adds \$40M in further stretchout costs. SOFIA is thus \$100M over budget!

SOFIA Program Management Team has been established. Will be reviewed more often. Oversight helped with valuable suggestions, but more reviews costs money & reduces productivity.

HQ has directed that SOFIA delivers observatory ASAP by relaxing requirements at ORR. Also mandate starting with a *minimum* of SIs at the beginning

SOFIA *not* spending more money; the budget is fixed, so schedule & scope have changed.

Telescope status: in good shape; primary figured. Structures partially done. 2nd/3rd mirrors done.

Aircraft: plane being worked on. In pieces. Will be ready next fall.

Observatory FRR in fall 2003.

Andy Harris asks why slow down SI funding when it is such a small savings. Cliff says that everything is being squeezed, even relatively small budget line items. Even down to the level of \$100K!

HQ Reorganization: Paul Hertz

SOFIA has very high visibility. Dan Goldin & Congress & OMB are watching!

Origins subcommittee in its last meeting says “notwithstanding the optimism expressed about the state of development, the OS remains concerned that SOFIA can be finished, and they support the effort to accommodate overruns within its current budget.” (not verbatim)

July 1 “streamlining” changed org chart somewhat. Now more hierarchical. Now there’s an “Astronomy & Physics Division” headed by Anne Kinney. Within A&PD, there are ASO and SEU themes. Paul Hertz is to be SEU theme scientist; Phil Crane is ASO.

Science Impact: Eric Becklin

The New Program:

Ed Weiler: “Get the Observatory in the air as soon as you can and get some science.”

IMR: “Fly it, then tune it.”

The ORR is being redefined (Davidson & Greene) to define slow science start in FY05. Not everything will fly initially! Phasing (Hertz & Greene) will be determined for SIs in October.

Other aspects: delay telescope simulator; delay EPO & other science racks; delay portions of MCS & DCS; consider delay in parts of pre-cool.

Science actions: AIRES has gone over by 75% budget; independent assessment review held. Bob Joseph chaired. Recommended cancellation of “present” AIRES. Center/USRA has not yet responded (i.e., not decided yet!).

Science advances: mirror coating facility tested. Others may want to rent.

Action Items Status: Jackie Davidson

Action items will be individually numbered, tracked, documented from now on. Format: “MM-XX” where MM is the SSSC meeting number, XX is the action item number.

16-01: link to SPIE papers has been done.

16-02: Access to Moffett field. Being worked for German nationals. Ongoing.

16-03: ICD tables do have dates for all documents.

16-04: SSMOC info completed.

16-05: Pump interface not yet determined.

16-06: Temp sensors on SM/TM. Some available.

16-07: AMCC for GUI: more to be done in August.

16-08: Transition ramp from nosedock to door. Not yet.

16-09: EMI from torque motor interference. 10s of microgauss. Waco tests in early 2004.

16-10: Can FLITECAM do water vapor monitoring? Don’t know yet. EXES may be involved.

16-11: Can FORCAST measure mirror emissivity? Ongoing.

16-12: Jackie’s numbering system (done).

16-13: SMA mass compensation to be increased; request sent to DLR.

16-14: SPIT to present status...

16-15: German data & SOFIA archive: German instruments not seriously involved.

16-16: TA subsystem tests have been listed.

16-17: Viewgraphs with test dates to be updated; this will not be done yet.

16-18: DCS discussions have started in Science Support Telecons.

Ralph Shuping at UCLA: DCS discussion. 1.5FTEs. Conceptualization complete by end 2001. Archive system done late 2003. Need input from SIs to help database development. Thinking about Observation Planning Tools (OPTs). Memo August 1.

16-19: Science Instrument capabilities:

Sean presented to Anne Kinney; discussed SOFIA capabilities, though not with minimum science goals at first light.

16-20: Jochen to give FLITECAM CADR lessons learned. Won't happen for a while.

16-21: "Friends of SOFIA" list for PR purposes. Put together.

16-22: Ed Erickson to organize Instrument Workshop in Summer 2002.

16-23: SOFIA email news notes to friends. SOFIA newsletter... by UCLA.

German Science Working Group Update: Jürgen Stutzki

Met July 2 in Cologne.

Discussed DLR/TA status. Prepared for SSSC.

Telescope Status: Alfred Krabbe

Primary: May 31st acceptance test by KT.

Diameter 2.705m; interferogram measures 2.6cm features. Roughness=1.5nm!

WFE=37nm RMS (diffraction-limited at 633nm). 80%EE 0.15''! WFE ~45nm RMS expected at 45°

Tertiary (upper):

Appears totally transparent!

Secondary:

Surface error 16nm RMS. Survives thermal cycling.

New Requirements for Operational Readiness: Jackie Davidson

Proposal from Tom Greene & Jackie Davidson for revised requirements to meet budget constraints. Answering Ed Weiler's request.

Proposed changes:

ORR image stability $\leq 2''$ (0.2'' original) with 3-year plan

IR Background 2x Nominal

40 teams/year observing within 3 years (originally at ORR)

1200 SFH in years 2+3; 960 SFH/year thereafter (maybe) (original 1+2)

At first light, image stability can be better than 2'' even without flexible body compensation.

IR background requirement assumes <10% emissivity (aluminized) <15% (dichroic) <25% (total).

Point-source sensitivity degradations to be worst at $\sim 10\mu\text{m}$ due to problems with image stability.

ORR predicted for July 2004.

Test schedule June-July 2004 has HIPO & FLITECAM, but not FORCAST. (2 months shorter!)

Limited testing of observing modes – TBD.

Paul Harvey will take any team out who makes their desired measurements on their first flight.

E&PO, Science Community Outreach: Steve Lord & Sean Colgan

New SOFIA web site released June 1. Vastly improved. More material available.

Access to web site has gone up, but newsletter was released June 1 also.

Personnel is being reduced (2->1). Emphasis in future to be updates & archive access, eventually user tools & documentation.

Science Community: no popular science articles, outreach at meetings.

Technical viewgraphs section on the web – (SAFIRE should add to it...)

Airborne Astronomy Symposium in July 2004?

SI Performance Descriptions should go onto the web. Uniform description of SI capabilities. Roughly 3 pages per SI. Format being developed by USRA; draft version available October. SI teams will have one month to review, posted to web site by December.

Examples SIPDs: page 1 could be spectral coverage information; page 2 could be sensitivity information; page 3 could be angular resolution (& coverage)

First call for proposals in March 2004.

Time estimator development: very preliminary; would like to have instruments online by Spring 2002. SSSC feels this is not so advisable, given that the SIPD would cover this fairly well.

US SI Budget for FY02-FY05: Eric Becklin

Total SOFIA SI Instrument funding:

Original funds \$20.4M; Original contracts \$13.7M; Original Contingency \$6.7M. All through end FY01.

Additional commitments made to AIRES & HAWC for \$3.0M; more misc. costs \$0.4M. Thus contingency prior to FY01 was \$3.5M.

Schedule extensions: EP13 (for 11 months in FY02) and ECP26 (for 24 months, FY03/FY04). Costs \$6.8M.

Total funding for SI through end FY04 is \$27.2M

Total extensions for SI costs less AIRES is \$7.7M. If AIRES is cancelled, will release \$1.5M.

Costs total \$22.7M

Remaining contingency is \$3.8M (\$2.3M if AIRES not cancelled).

FY05 has \$3M on the books. Further instruments from the FY06+ budgets.

Claim that SAFIRE received original \$1500, \$516K additional extension. \$1M sent so far, \$116K for FY01, \$300K for FY02/03/04 to reach total of \$2016.

US SI Phasing Introduction: Tom Greene

SOFIA Science Status: different from most other observatories: big science scope, not prioritized.

SOFIA is delayed to be operational in late FY04, and has a tight (instrument) budget.

IMR says “best SOFIA instruments – which exploit uniqueness – will not be available at start of operations.”

Every instrument trying to make first light but those with no detector development are proceeding more quickly. However, complex instruments are those which take best advantage of SOFIA.

Comments:

Ed Weiler: SOFIA should start science flights ASAP.

IMR team: Do this even if it means putting instruments on hold.

Ed Weiler: You will have to cut instruments (for budget or schedule). It will be painful.

IMR has asked SOFIA to review science priorities & instruments. High priority instruments to be ready at first light.

Phasing determined by:

Science need & uniqueness intrinsic to SOFIA (i.e., compared to SIRTf & Herschel)

Expected first light performance

Instrument development status & schedule

Available funds – reallocations possible.

Must have ≥ 2 instruments at first light.

Early schedule to mix science & engineering.

Goal is to get SOFIA doing first-rate science mid 2004 with limited initial instrument complement.

SSSC must give input today; USRA will draft phasing plan to be reviewed by Phasing Review Committee; implemented early FY02 (e.g., by Dec 2001).

All SI PIs will explain their compelling science and when their instruments can be delivered.

Entire SSSC will discuss phasing later today.

German instruments treated separately.

If there is concurrence, this phasing plan will be submitted as a draft of the draft.

Phasing Review Committee: charter is to (1) define unique capabilities (2) recommend instrument funding priorities (3) identify instrument minimum requirements (4) review observatory and DCS minimum requirements (5) review phasing of SOFIA into operations phase (6) determine whether instrument funding will enable the high priority instruments.

Phasing Review Committee may just review rather than contribute. Membership TBD (SSC, SSSC, IMR members). Schedule to hold ~1 October.

HIPO: Ted Dunham

HIPO status: Much hardware done or nearing completion.

Plan is to pass CADR, then begin fab in early 2002.

First light science: High speed motions will blur, but lower speed will not (fast readout).

Projects: occultations; planetary atmospheres; KBOs

Occultation event rate less than one per week; could be much lower.

FLITECAM: Ian McLean

Status: first light on the ground in Fall 2002. Will be ready for SOFIA in the beginning.

Have not yet started making cryostat. Passed CADR in Feb 2001.

Optical components orders or in-hand. Optomechanics in fabrication. Much of DAQ electronics finished; working on rack & software.

Science for high angular resolution; will be degraded

EXES: John Lacy

Covers 5-8 μ m and 17-28 μ m with R=4000, 15K, and 50-100K.

Uses 256² array; could expand to 512². Might extend wavelengths to 17-40 μ m.

Status: electronics, software in hand; grating tested; mechanical in progress.

Anticipate delivery Oct 2004.

Science:

simple molecules (H_2O , CH_4) toward protostars. Can observe ~12 bright sources with first light image stability.

Longer wavelengths: H_2 S(0) at $28\mu\text{m}$, S(1) at $17\mu\text{m}$; [SiII] at $35\mu\text{m}$ possible with Si:Sb array.

Planet-forming disks around PMS stars – not easy with $2''$ stability.

IMC possible, but a difficult solution to use focal plane mirror (prefer to move secondary).

FORCAST: Terry Herter

Will be ready at first light; used on ground-based telescope.

Can do compelling science at first light; can shift-and-add to correct pointing.

Timeline: hardware moving slowly due to low funding. Array in hand soon. Many components purchased or in process.

Science:

- Imaging Vega-like debris disks

- Nature of Sgr A*

- Heating Galactic Center circumnuclear ring

- Protostellar disk imaging (impacted by stability)

- Spiral structure in nearby galaxies (impacted by stability)

- Nature of PAHs in ISM (impacted by stability)

HAWC: Al Harper

HAWC passed CDR; development plan slowed. Subsystems like ADR tested; arrays in progress.

HAWC will be ready for first light; will integrate well with SIRTf/Herschel

Science priorities:

- Galactic Center

- ULIRGs

- AGN; circumnuclear starbursts

- Star formation in variety of environments

- Debris disks

HAWC will be diffraction-limited, so first light stability irrelevant.

Old AIRES Science: Sean Colgan

Studies of Galactic Center; dynamics, physics

Low-mass star formation

ISM Chemistry: interactions of dust & gas, shocks

Primordial deuterium abundance

Evolution of matter

Cosmic recycling

“Serendipitous science”

Timeliness: 3 of 5 SIRTf programs are appropriate for ARES-like followup.

Image stability not a problem with 8” slit.

CASIMIR: Andy Harris

Spectral resolutions 10^4 - 10^6 , covering 500-2000 GHz. First light instrument only at lower frequencies. 2 cryostats/4 bands. First light 800-1200 GHz. Longest wavelength instrument for SOFIA.

First light performance not affected by SOFIA.

Science:

Galactic/extragalactic star formation; velocity-resolved spectra

Hot molecular gas: shocks & PDRs

Interstellar chemistry: line surveys, rare species, interstellar hydrides.

Punchline: water! Is a reservoir for Oxygen, traces shocks, and is poorly understood after SWAS.

Summary: high sensitivity. Pathfinder for Herschel. Product will be spectra & small images.

All high-risk technology demonstrated for first-light version. FAA certification uncertain.

Certified by beginning FY05.

SAFIRE: Dominic Benford

US Science Instrument Discussion

Group has many conflicting ideas...

Low risk observations first, leading to future observations

Uniqueness is important. Demonstrate the capability of observatory.

Imaging being pressed from both sides; 0.1” imaging in 2005 by Gemini at 10 μ m and ALMA at 400 μ m.

Operational efficiency should be a consideration.

Proposals for first light observations could be made, so a science program can be chosen.

FIFI-LS: Les Looney

Two channels: “blue” and “red” covering 42-210 μ m. Both available at first light.

Gratings in hand; detector arrays in progress (blue finished; red in production)

Software is biggest concern; CADR in Summer 2002.

Science:

Extragalactic star formation; [CII] line [OI] and [OIII] lines.

Powering of ULIRGs. AGN/Starburst. Mergers

Unification schemes of AGN; ISM in early-type galaxies; outflows from YSOs.

GREAT: Jürgen Stutzki

Similar to CASIMIR. Bands around 158 μ m (1.6-1.9 THz), HD/OH lines (2.4-2.7 THz) and OI line (4.5-4.8 THz). CASIMIR/GREAT can share AOS and other backends.

Should be ready for first light with at least one band.

Dewar designed; Δ CADR late 2001. Frame in design.

Obvious science topics; very line-specific.

STAR (SOFIA THz Array Receiver) may start funding 2003...

US SI Phasing Summary: Tom Greene

SSSC did not agree on how to significantly reign in first light SOFIA science capabilities.

Some agreement was reached on:

Must have capabilities to commission SOFIA

Should demonstrate strength of observatory

Unique capabilities needed

“Something that will work” should be done

Some consensus that some imaging capabilities are needed at first light.

Constraints:

Only ~20 flights for US SIs in 2005! (HIPO/FLITECAM can be excluded)

Instruments drive observatory modes and have commissioning overheads

Is instrument budget reserve adequate (~30% on remaining expenditures) for completing entire US complement?

(Note: Lacy suggests EXES might be a candidate for phasing in at second year.)

Suggested a bottoms-up reference mission of a compelling observations for first few years. This science could be prioritized and applied to flow down to instruments. Unfortunately, this may take too long and the reference mission would probably require most instruments anyway. As an alternative, a very small set of projects – 1 or 2 – could be selected.

Suggestions that instrument teams help observatory (e.g., in supplying MCS coding) and that instrument teams share resources.

Summary: Jackie Davidson

Next SSSC meeting in mid-October sometime... how about Friday 12 Oct.

Few action items assigned. More to come.